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Impulsivity and Obesity in Adolescents

A Senior Honors Thesis

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By

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Impulsivity and Obesity in Adolescents

When we hear the word “epidemic”, we usually associate it with pathogenic infections that affect only undeveloped third world countries and could otherwise be prevented with better hygiene practices or access to clean drinking water. Obesity is quickly becoming America’s own “epidemic”, with dramatic increases across the country during the last 20 years. In 2008, only one state (Colorado) had a prevalence of obesity less than 20%. Thirty-two states had prevalence equal to or greater than 25%; six of these states (Alabama, Mississippi, Oklahoma, South Carolina, Tennessee, and West Virginia) had a prevalence of obesity equal to or greater than 30% (e.g. Centers for Disease Control and Prevention, 2008). Even more alarming, obesity is now the most prevalent nutritional disease of children and adolescents in the United States. Additionally, obesity in childhood and adolescence can lead to the early stages of coronary heart disease, diabetes, and various cancers (Dietz, 1997). Defining a behavioral profile most associated with adolescent obesity could provide insight into prevention and treatment methods from an early age.

There has been little research done to explore the relationship between impulsivity and obesity, and almost none that looks specifically at the relationship between impulsivity and obesity in adolescents. Exploring these associations could provide clues towards improving our understanding of this growing epidemic and insight into prevention of adult obesity later in life.

Obesity

Overweight and obesity are both labels for ranges of body weight that are greater than what is generally considered healthy for an individual of a given height. These terms also

identify ranges of weight that have been shown to increase the likelihood of certain diseases and other health problems. Ranges for these weight classes can be determined using height and weight measurements to calculate a body-mass index, or BMI. In children aged 2-20, these values are compared on a standardized table of percentiles to determine what would be a "normal" or healthy weight for that age group (e.g. Centers for Disease Control and Prevention, 2008). Although BMI is not always accurate, BMI-for-age when used on schoolchildren aged 2-19 was found to be significantly more accurate than weight-for-height assessments or the Rohrer Index (RI) in detecting overweight children (Mei et al, 2002). The Centers for Disease Control and Prevention and the American Academy of Pediatrics recommend the use of BMI to screen for overweight or obese children and teens (2011).

Childhood obesity is increasing at an alarming rate worldwide. The prevalence of being overweight in adolescence increased from 6.1 percent to 17.6 percent between 1974 and 2003. Among non-Hispanic whites, 31.9 percent of males and 29.5 percent of females between the ages of 2 and 19 are considered overweight or obese with even higher percentages for African American and Hispanic populations (American Heart Association, 2010). Obese and overweight individuals are more susceptible to a number of life-threatening diseases, including coronary heart disease, Type 2 diabetes and certain cancers (Centers for Disease Control and Prevention, 2009). In addition to the health consequences, the cost of obesity in the United States alone is an estimated $147 billion dollars annually, with the cost of prescription drugs being responsible for the majority of the bill. This number does not account for the disabilities and early deaths incurred by those individuals with the disease (Reinberg, 2010).

With childhood obesity becoming even more of a problem in recent years, both for its negative health impacts and strain on the economy, it's no wonder this issue has come to the

forefront of important public health initiatives. In addition to national campaigns encouraging children to eat healthier and engage in more physical activities, recent evidence of a possible relationship between impulsivity and obesity in this younger population is an exciting and positive new development. With further research, impulsivity may prove to be an important behavioral construct to consider in our efforts to reduce childhood obesity.

Impulsivity and Delay Discounting

Various measures have been developed to assess different facets of impulsivity, including self-report measures of personality that rely on an individual's self-perceptions of his or her own behavior and behavioral tasks that quantitatively measure behavior related to specific dimensions of impulsivity (Reynolds et al. 2006). Characteristics of impulsivity can lead to a variety of addictive behaviors, such as drug use, alcohol use, and gambling (e.g. Reynolds, 2006). Additional studies have shown that drug addiction and food addiction are closely related conditions, making impulsivity a particularly relevant construct to measure when examining overweight and obese populations (Merlo et al, 2009).

Self-report measures are able to define a broad range of behaviors associated with impulsiveness, and these assessments efficiently measure multiple characteristics that give an overall view of a person's level of impulsivity (Patton et al, 1995). Research using self-report measures of impulsive behavior has shown that obese adults are more impulsive than normal-weight individuals and show co-morbidity with other impulsive behaviors, like substance abuse (Nederkoorn et al., 2006). Other studies have found this same trend of self-reported impulsive behavior when food is used as a motivator. When presented with an unlimited amount of food (e.g. a bowl of candy), people who rated themselves as more impulsive ate significantly more

candy than people who viewed themselves as less impulsive (Guerrieri et al, 2007). Impulsiveness has also been shown to correlate directly with obesity between different weight groups. In a study of obese women, group weight differences correlated significantly with motor impulsiveness on the Barratt Impulsiveness Scale, but not in the nonplanning or cognitive subscales (Nasser et al, 2004).

Self-report measures are sometimes susceptible to respondent bias, and therefore using computerized behavioral tasks to assess impulsive behavior in conjunction with self-reports can provide a more complete assessment of impulsivity. One commonly used behavioral assessment of impulsive behavior is delay discounting. Delay discounting is measured by making choices between lesser, immediate rewards and larger, delayed rewards. Comparatively more choices for lesser, immediate rewards reflect greater impulsivity. For example, the choice between staying in to study for next week's exam and attending an all-night party with friends is a real-life example of delay discounting. Getting a good grade on the test represents a more valuable long-term outcome, whereas attending the party represents a less valuable immediate outcome. In a laboratory setting, delay discounting can be measured by giving participants choices between different monetary values in a computerized behavioral task. A choice between five dollars now and ten dollars in 30 days would be answered differently depending on how much an individual discounts value by delay. Someone who chooses five dollars now would be considered more impulsive and have a higher level of discounting, whereas someone who chooses ten dollars in a month would be less impulsive and have a lower level of discounting.

Delay discounting has been measured in conjunction with different health behaviors, particularly addiction. There is strong evidence supporting the assertion that highly-addicted individuals also have higher levels of delay discounting. In a study that examined substance

abusers, cigarette smokers, and non-addicted individuals, both the substance abusers and smokers were found to have significantly higher levels of delay discounting than non-addicted participants (Businelle et al, 2010). Among adolescents, the trend between delay discounting and substance abuse is similar. In a sample of adolescent cigarette smokers and nonsmokers, smokers discounted significantly more than nonsmokers in a decision-making task (Fields et al, 2009).

Delay discounting also has been studied in obese individuals, based on the assertion that obesity can be the result of addictive behavior involving food. In a sample of college students, obese women discounted more than normal weight women (Weller et al, 2008). However, further research in this area is needed to determine why this result was not found among males. In a similar study, high percent body fat was correlated with higher levels of discounting when compared with normal percent body fat groups in adults (Rasmussen et al, 2010). Although this pattern has been relatively consistent among adults, there has been little work done to explore the relationship between weight and delay discounting among adolescents. However, a study that examined delay discounting among adolescent smokers found that obese smokers discounted significantly more than normal-weight smokers (Fields et al, 2011). The relationship between delay discounting and weight status could potentially be replicated in adolescents, but research to further confirm these findings is needed.

The current project explored associations between a self-report measure of impulsivity, a behavioral assessment of delay discounting, and weight status in three adolescent weight groups: normal weight, overweight, and obese. Also, an eating questionnaire was included to more specifically evaluate self-control in relation to eating behavior. We hypothesized that less restraint with respect to food-intake would be associated with higher weights. Given previous research, we also hypothesized that obesity would be associated with greater impulsivity on both

self-report and behavioral measures. That is, we expected the obese BMI group to discount the most, the normal weight group to discount least, and the overweight group to discount intermediately. These findings would represent an important aspect of defining a behavioral profile related to obesity.

Methods

Participants

A total of fifty-six adolescents between the ages of 14 and 16 were recruited from the Columbus area and through a database maintained by Nationwide Children's Hospital. Participants within the specified age range were recruited based on BMI level (verified by a height and weight measurement) and a non-smoking, non-depressed status. Both smoking and depressed populations were eliminated due to previous research, which has shown these factors to correlate positively with impulsivity in adolescents (Fields et al, 2009; Imhoff, 2009). A carbon monoxide (CO) breath analyzer was used to determine smoking status, with participants having a breath CO level greater than 5 ppm not included in the study. A non-depressed status was verified using the Beck Depression Inventory, with recommended cutoff scores used to screen for depression (Beck, 1996). Participants were recruited to form three groups: normal weight (between 5^{th} and 85^{th} percentile by gender), overweight (between 85^{th} and 95^{th} percentile by gender), and obese (greater than or equal to 95^{th} percentile by gender).

Dependent Measures

Impulsivity

Barratt Impulsiveness Scale (Adolescent Version) (BIS-11-A; Fossati et al, 2002). This is a 30 item self-report measure of impulsive characteristics that has been adapted for adolescent use from the original adult version (Patton, Stanford & Barratt, 1995). The adult version is divided into six subscales: Motor Impulsiveness, Cognitive Complexity, Self-Control, Lack of Delay, Attention, and Perseverance. Correlations among these variables are significantly higher for adolescents than for adults; therefore, BIS-11-A total scores are recommended to be the best indicator of impulsivity in adolescents. Fossati et al. (2002) noted that internal consistency was adequate with adolescents, with a Cronbach's alpha of .78.

Question-based delay discounting measure (Richards et al, 1999). This computerized task calculates the rate at which a participant chooses a smaller, immediate reward over a larger, delay reward (e.g., Would you rather receive 5 dollars now or 10 dollars 30 days from now?). The delayed amount of money is fixed at 10 dollars and is set at different time periods: 1, 2, 30, 180, and 365 days. The amount of immediate money offered varies randomly across questions by ± .50 cents until an indifference point between delayed and immediate choice options is established across each delayed time period. The indifference point is the amount at which the smaller, immediate reward is of equal choice value to the larger, delayed reward. Participants are told their choices are important because at the end of the task one question will be chosen at random and paid to the participant. If the randomly selected choice was for an immediate amount, the participant received the money at the end of their research session. If the randomly selected choice was for a delayed amount, they would receive that money after the specified delay.

Weight Related Eating Questionnaire (Schembre, Greene & Melanson, 2009). This is a 16 item self-report measure of eating behaviors with a four-factor structure. It measures two constructs of dietary restraint (routine and compensatory restraint), susceptibility to external cues (external eating), and emotional eating. The WREQ has demonstrated good preliminary construct validation against similar measures of eating behaviors, BMI, and dietary intake (Schembre, Green & Melanson, 2009). These findings support the use of the WREQ as a measure of eating behavior for this study. Only dietary restraint was assessed, as this dimension was most relevant to our research questions involving impulsivity and self-control.

Procedure

Subjects were screened prior to participation over the phone to determine eligibility. Before beginning the research session, informed consent was obtained from a parent or legal guardian, and assent was obtained from the adolescent. Height and weight measurements were verified using scales, and BMI was then calculated. Smoking status was verified using exhaled carbon monoxide (CO). Following smoking status verification, participants completed the Kaufman Brief Intelligence Test: Second Edition (KBIT-2) (Kaufman and Kaufman, 2004) to assess verbal and non-verbal ability. Participants then completed self-report measures that assessed depression and impulsivity. Those participants scoring higher than a 13 on the Beck Depression Inventory were also excluded from the data set. The computerized behavioral tasks followed the self-report measures (see Dependent Measures). After completing the approximately two and half-hour lab session, participants were debriefed and compensated for their participation. Payment ranged from $25 to $35, which was partially based from performance on laboratory behavioral task

Data Analyses

An area-under-the-curve (AUC) method was used to analyze data from the delay discounting task (Myerson, Green & Warusawitharana, 2001). Values for AUC are determined by plotting the five indifference points observed during the computerized discounting task to form a curve. The curve forms four distinct quadrants based on the length of delay. Quadrant I is found between the 1 and 2 day delays, Quadrant II is between the 2 and 30 day delays, Quadrant III is between the 30 and 180 day delays, and Quadrant IV is between the 180 and 365 day delays. The AUC for each of these quadrants can be added together to determine the total AUC. Utilizing this method, smaller AUC values indicate a higher level of delay discounting; and, conversely, higher AUC values indicate lower delay discounting.

SPSS version 17.0 was used for all statistical analyses. Median household income is a continuous variable, and was analyzed using covariate analyses. All other comparisons were made using separate one-way analyses of variances (ANOVAs). LSD post-hoc tests were used to examine the specific differences between each of the three groups. These analyses used BMI level as the grouping variable.

Results

Participant Demographics

Self-reported demographics and BMI data are presented in Table 1. The three groups had significantly different BMI levels from one another, therefore providing verification of weight group classification. All participants used in analyses had low breath-CO levels and depression scores verifying a non-smoking and non-depressed sample. There were significant differences in median household income between the normal weight group and obese group, as well as the

overweight group and obese group. The normal weight group and overweight group did not themselves differ.

Table 1

Participant Demographics and BMI

	Normal	Overweight	Obese
	(*n* = 20)	(*n* = 16)	(*n* = 20)
Age (in years)	15	15.1	14.9
Gender (% female)	60	56	55
Race (% B:W:O)	45:45:10	68:13:19	65:15:20
Income (Mdn Household)*†	$49,276[a]	$45,091[a]	$38,001[b]
Body-Mass Index (BMI)**†	20.4[a]	26.0[b]	34.5[c]
CO (ppm)	0.78	0.36	0.89
KBIT	91	89	93

Note. *The median annual household income was calculated based on average income for postal zip code region of the participant's residence. **Body-Mass Index (BMI) was obtained using height and weight measurements taken during the laboratory assessment, and then calculated using a Child and Teen Body-Mass Index Calculator (Centers for Disease Control and Prevention, 2011). †Different superscript letters indicate statistical significance between groups.

Dependent Measures

There were no significant findings for the BIS-11-A, the self-report measure of impulsivity. Although our original hypothesis was not confirmed, Figure 1 shows a noticeable trend between groups, with higher weight participants reporting higher levels of impulsiveness.

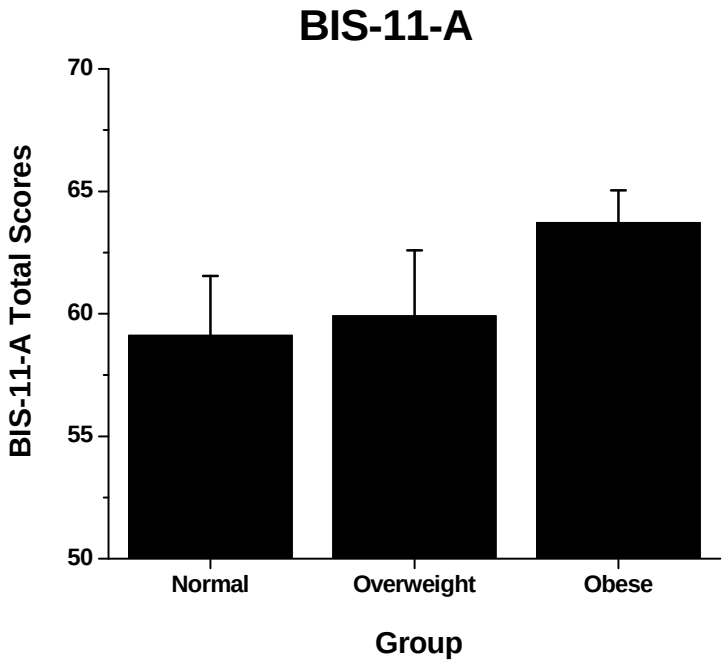

Figure 1: BIS-11-A Total Scores Among Normal Weight, Overweight, and Obese Participants

On the DDQ, there was a significant overall effect of weight status [F (2, 55) = 9.09, p = .001]. Post-hoc analyses (LSD) revealed that overweight and obese adolescents discounted more impulsively than normal-weight participants. The overweight and obese weight groups did not significantly differ from one another. Figure 2 shows the median indifference points at each delay for each of the three groups.

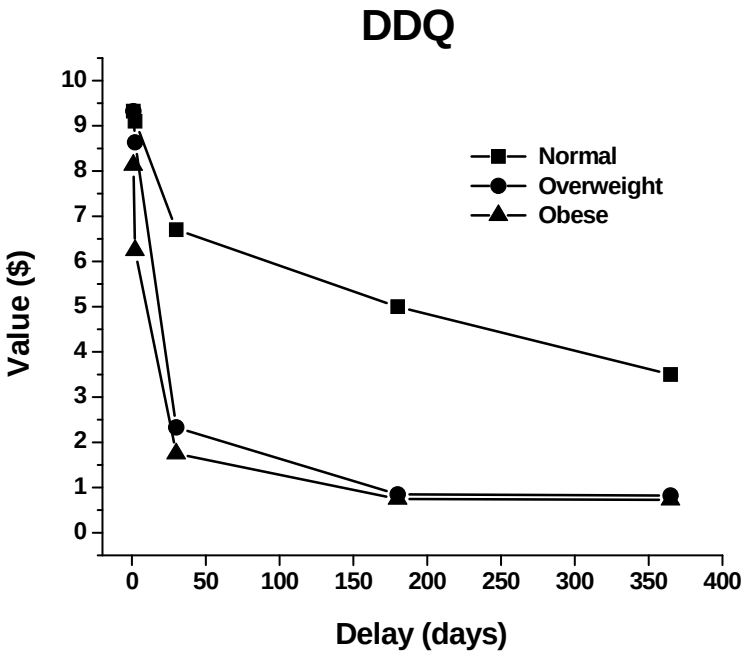

Figure 2: Delay Discounting Indifference Points Among Normal Weight, Overweight, and Obese Adolescents

The WREQ also showed a significant overall main effect of weight status [F (2, 55) = 7.44, p = .001]. Follow-up analyses revealed that overweight and obese adolescents reported more restraint than normal-weight adolescents. Overweight and obese adolescents did not significantly differ in their restraint scores. A correlational analysis was conducted using results of the DDQ and WREQ, but despite similar patterns of results across these measures there was no significant correlation. Figure 3 reports the median scores restraint scores across the three weight groups.

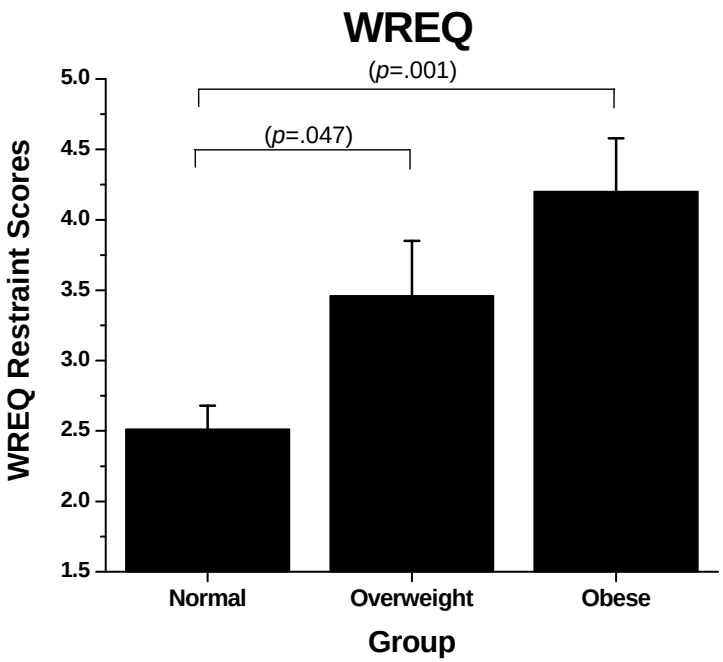

Figure 3: WREQ Restraint Scores Among Normal Weight, Overweight, and Obese Adolescents

From Table 1, there were significant group differences in median household income. To test if these differences accounted for the significant effects found with the measure of delay discounting and the eating restraint scores, these analyses were repeated while controlling for differences in income as a covariate. Group differences remained significant for both the DDQ [$F (2, 55) = 8.91$, $p = .001$] and the WREQ [$F (2, 55) = 4.93$, $p = .011$].

Discussion

This project examined the relationship between assessments of impulsivity and weight status in adolescents. The hypothesis that there would be group differences in impulsivity between normal weight, overweight, and obese adolescents was confirmed. The hypothesis that restraint scores on the WREQ would differ with higher-BMI individuals reporting less restraint in their eating habits was not confirmed.

Delay discounting results did significantly differentiate the three groups. Normal weight adolescents discounted significantly less by delay than the overweight and obese weight groups. Overweight and obese participants did not significantly differ across this measure of delay discounting.

The delay discounting results reveal aspects of how these three groups differ with regard to time perspectives. The current findings indicate that adolescents who are overweight or obese are more immediately oriented. That is, both obese and overweight individuals displayed behavior that is more controlled by immediate circumstances. Adolescents with higher body-mass indices may prefer instantaneous rewards and not consider the long-term consequences of their actions, making them more likely to initially become overweight or obese. The action of over-eating is an immediately gratifying choice, and also one which overweight or obese adolescents may be predisposed to make.

Findings with self-reported impulsivity did not confirm the original hypothesis. Although the pattern of results were as expected, the differences between the three groups were not significant. This lack of association may be due to the nature of self-report data. That is, adolescents participating in the study may have been unable to give fully accurate representations of their impulsiveness based on the questionnaire.

Results from the WREQ significantly differentiated the three groups, but was not consistent with the original hypothesis. Obese and overweight adolescents reported having higher levels of food-related restraint than the normal weight group; however the obese and overweight groups did not significantly differ between themselves. Although these results are counter-intuitive, they are consistent with the literature results (Schembre, Green & Melanson, 2009).

The pattern of WREQ results may be partially explained by self-image. Overweight and obese adolescents are likely to know that they are heavier-than-normal and would be more likely to try dieting in order to lose weight. A crucial aspect of dieting is restraining one's intake to consume healthier food, or simply less food. Overweight and obese participants may have been reporting higher levels of restraint in response to weight-loss efforts. The overweight and obese participants' comparatively high restraint scores may also be somewhat attributable to the Hawthorne Effect. Knowledge that they are participating in a study may make them more conscious of what kind of behavior they report exhibiting in their private lives. Additionally, these individuals may want to appear a certain way to the experimenter, and therefore report having uncharacteristic answers to questions they feel they "should" be answering differently. The negative stigma surrounding overweight and obese individuals in society may account for them reporting unrealistically good behavior on a self-report measure in order to appear motivated in losing weight.

A limitation of this study was the small sample size (n = 56). With a larger sample size, it is possible that some of the effects would become significant (e.g. findings with the BIS-11-A). Another limitation is that these adolescents were not clinically screened for depression, a factor which may have influenced their levels of delay discounting (Imhoff, 2009). While the Beck

Depression Inventory is a valid measure for assessing depression, in order to more fully confirm a depression status it would be advisable to obtain a diagnosis from a trained medical professional.

The findings obtained in this study indicate that delay discounting is a behavioral style that underlies being overweight or obese during adolescence. These individuals may have been predisposed to becoming overweight or obese based on their initial levels of impulsiveness with respect to decision-making. In a study examining obesity treatment in a sample of children, impulsivity predicted therapy outcome (Nederkoorn et al, 2006). Overweight and obese children were evaluated for levels of impulsivity before a weight-loss program. More impulsive children were found to have significantly higher BMI's than children who performed less impulsively. Results also demonstrated that impulsivity predicted treatment success, with the most impulsive children losing the least weight during the program. Even 12 months after the program ended, the more impulsive children were the most overweight and had the least success in losing weight. When considering more effective prevention and treatment methods for overweight or obese adolescents, therapy concerning specific ways to cope with impulsivity would be useful to increase the likelihood of weight loss. This pattern of findings is similar to findings involving drug use/addiction and implies a link between obesity and other addictive behaviors.

In conclusion, this study provides evidence that overweight and obese adolescents are significantly more impulsive than normal weight adolescents on a measure of delay discounting. These results also demonstrate that delay discounting results between overweight and obese adolescents are almost indistinguishable. Obtaining a larger sample size may provide more comprehensive results of any existing differences in impulsivity between these two weight groups. This study is novel in its use of three distinct adolescent weight groups, and further

prospective research may be needed to clarify any causal associations between impulsivity and BMI, and the degree to which these adolescents are at greater risk of becoming overweight or obese.

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Appendix A

ASSENT TO PARTICIPATE IN RESEARCH
(FOR SUBJECTS 9 YEARS UP TO 18 YEARS OF AGE)

Study Title: Neurocognitive Assessments and BMI

Study Doctor: Dr. Brady Reynolds

Subject's Name: _____ Date of Birth: _____

You are being asked to be in a research study. Studies are done to find better ways to treat people or to understand things better.

- **This form will tell you about the study to help you decide whether or not you want to volunteer to participate.**
- **You should ask any questions you have before making up your mind. You can think about it and discuss it with your family or friends before you decide.**
- **It is okay to say "No" if you don't want to be in the study. If you say "Yes" you can change your mind and stop being in the study at any time.**
- **If you decide you want to be in the study, an adult (usually a parent) will also need to give permission for you to be in the study.**

1. **What is this study about?**

   This study is about the factors that cause teenagers to have different eating habits and levels of stress.

2. **What will I need to do (what will be done to me) if I am in this study?**

   The study will take place at Nationwide Children's Hospital with one visit, which will take about 2 hours. During this visit you will complete questionnaires, computer tasks, and face-to-face interviews. You will also be asked to provide a breath sample and have your height and weight measured. The breath sample will test for cigarette smoking only.

   When you arrive, you will start the session by giving a breath sample, as well as a height and weight measurement. Then you will complete a learning, thinking, and problem-solving task that will take about 30 minutes to complete. After this you will be offered a 5 minute break. Then you will spend about 30 minutes completing paper and pencil

questionnaires. Some of these questionnaires ask questions about your eating habits, activities, and personality as well as substance use. Your answers to these questions are confidential, which means only the study Investigator and study staff, have access to your answers. Also, to protect your privacy, your name will not be on the surveys. When you are finished with these, you will be offered another 5 minute break. After the break, you will complete a group of computer tasks that will take about one hour. These computer tasks will give you the opportunity to earn money based on the choices you make while doing the tasks. You will get to keep the money you make during these tasks.

3. How long will I be in the study?

The study will last about 2-3 hours.

4. Can I stop being in the study?

You may stop being in the study at any time.

5. What bad things might happen to me if I am in the study?

The computer tasks can become a little boring after awhile, but you can stop and leave the study at any time. You can keep all money you have made up until that point.

6. What good things might happen to me if I am in the study?

You may not directly benefit from being in this study, but it might help us gather some information to benefit other people in the future.

7. Will I be given anything for being in this study?

You will have the opportunity to earn $25 to $35 depending on your performance during the computer tasks.

8. Who can I talk to about the study?

For questions about the study you may contact Dr. Brady Reynolds at 614-722-3549.

To discuss other study-related questions with someone who is not part of the research team, you may contact the Institutional Review Board Office (the group that reviews all human subject research) at 614-722-2708.

Signing the assent form

I have read (or someone has read to me) this form. I have had a chance to ask questions before making up my mind. I want to be in this research study.

_____

Printed name of subject

_____ _____

Signature of subject **Date**

Investigator/Research Staff

I have explained the research to the participant before requesting the signature above. There are no blanks in this document. A copy of this form has been given to the participant or his/her representative.

_____ _____

Printed name of person obtaining assent **Signature of person obtaining assent**

_____

Date

This form must be accompanied by an IRB approved consent form signed by a parent/guardian.

CONSENT TO PARTICIPATE IN A CLINICAL RESEARCH STUDY

STUDY TITLE: Neurocognitive Assessments and BMI

PRINCIPAL INVESTIGATOR: Dr. Brady Reynolds

CONTACT TELEPHONE NUMBER: 614-722-3549 ***(24 hours a day, 7 days a week)***

STUDY SPONSOR: **The Research Institute at Nationwide Children's Hospital**

SUBJECT'S NAME: _____ *DATE OF BIRTH:* _____

NOTE: The words "you" and "your" are used in this consent form. These words refer to the study volunteer whether a child or an adult.

1) INTRODUCTION

We invite you to be in this research study. Participation is voluntary. Please learn enough about this research study, its risks and benefits, to decide whether you should agree to participate. We will explain the study to you, and give you a chance to ask questions about anything you do not understand. This process is called "informed consent". It is up to you to choose if you want to be in this study. You may refuse to be in this study or quit this study at any time.

Before agreeing to participate, it is important to read and understand the study information in this consent form**.** By signing the consent form, you agree to be in this study.

If this study involves a child between 9 and 18 years of age, he/she must also agree to be in the study by signing an Assent form or on the assent line of this form.

You will be given a signed and dated copy of the consent and the assent form.

2) WHY ARE WE DOING THIS RESEARCH STUDY?

This study is intended to help us better understand differences in eating habits and stress level among adolescents. It is expected that we will be able to identify some of the key factors that influence harmful eating habits and use this information to develop better forms of treatment and prevention.

3) WHERE WILL THE STUDY BE DONE AND HOW MANY SUBJECTS WILL TAKE PART?

This study will be done at Nationwide Children's Hospital. We hope to enroll 60 subjects. All 60 participants will complete their sessions here at Nationwide Children's Hospital.

4) WHAT WILL HAPPEN DURING THE STUDY AND HOW LONG WILL IT LAST?

This study will involve an initial visit to Nationwide Children's Hospital for a research session that will last about 2 to 3 hours. First, the participant will blow into a hand-held meter, which will show if he/she recently smoked a cigarette. The participant will also be weighed and have their height measured on a standard medical scale.

Next, the participant will complete a learning, thinking, and problem-solving task that will take about 30 minutes to complete. After this, the participant will be offered a 5 minute break.

Next, the participant will complete questionnaires. Completing these questionnaires will take about 30 minutes. Some of the questionnaires include personal questions about your eating habits, activities, and personality as well as substance use, but these questions will not be tied to your name or other identifying information. All questionnaires will be kept confidential by using an ID number and stored in a password-protected computer file. After the questionnaires are done, another 5 minute break will be offered. Then the participant will complete computer tasks. This will take about 1 hour.

After completing the computer tasks, any questions about the study will be answered.

Participants will be compensated for this session based on computer-task performance (between $25 and $35). These computer tasks offer the opportunity to earn money based on choices made during the tasks. If the participant decides to quit the study before completing all of the computer tasks, he or she will get to keep whatever money has been earned up until that point, with a minimum of $25. Also, $5 will be allotted for travel expenses.

Session Activities (2-2.5 hours):

1) Teen and parent read and sign consent and assent forms
2) Give breath sample and obtain height and weight measurements (5 minutes)
3) Complete learning, thinking and problem-solving tasks (about 30 minutes)
4) Break (about 5 minutes)
5) Complete paper questionnaires (about 35 minutes)
6) Break (about 5 minutes)
7) Complete computer tasks (about 1 hour)
8) Compensation

WHAT ARE THE RISKS OF BEING IN THIS STUDY?

Being in this study involves little to no risk to the participant. All data will be coded with subject numbers so that the data will be separate from personally indentifying information. However, loss of confidentiality is possible, but all steps will be taken to avoid this from happening.

Some of the computer tasks may become boring, but the participant is able to withdraw from the study at anytime during the procedure. The participant can keep whatever money had been earned to that point.

There may be other risks of being in this research study, which are not known at this time.

ARE THERE BENEFITS TO TAKING PART IN THIS STUDY?

There will be no benefit to you from being in this study, but we might learn something that could help others.

WILL THERE BE ANY COSTS TO ME?

It will not cost you anything to be in this study. For your time and participation, the participant will receive between $25 and $35, depending on computer task performance, as well as $5 for travel expenses. Also, we will pay for your parking while you are in this study.

8) WHAT HAPPENS IF BEING IN THIS STUDY CAUSES INJURIES?

If being in this study causes an injury, Nationwide Children's Hospital will provide medical care. You or your insurance company may have to pay for the cost of this care. This does not mean that you give up any of your legal rights to seek compensation for your injuries.

9) WHAT HAPPENS IF I DO NOT FINISH THIS STUDY?

It is your choice to be in this study or to stop at any time. If you decide to stop being in this study, it is OK, but you must call the Principal Investigator or the study coordinator.

If you stop being in the study, there will not be a penalty or loss of benefits to which you are otherwise entitled.

10) HOW WILL MY STUDY INFORMATION BE KEPT PRIVATE?

Information collected for this study will be kept confidential to the extent provided by law. Each participant will be assigned a participation identification code. In the event of any publication regarding this study, your identity will not be revealed.

Protected Health Information that may be used or disclosed:

- Date of birth and contact information

People or Companies authorized to use, disclose, and receive PHI collected or created by this research study:

- ***Dr. Brady Reynolds and his study staff***

- ***The Nationwide Children's Hospital Institutional Review Board (the committee that reviews all human subject research)***
- ***Nationwide Children's Hospital internal auditors***
- ***The Office for Human Research Protections (OHRP) (the federal government office that oversees human subject research)***

Because of the need to give information to these people, absolute confidentiality cannot be guaranteed. Information given to these people may no longer be protected by federal privacy rules.

Reason(s) why the use or disclosure is being made:

Exceptions to confidentiality would include any significant information about child abuse or neglect, as well as reports that suggest you or someone else would be placed in a potentially life-threatening situation if confidentiality were maintained.

Also, if your child expresses any suicidal thoughts, feelings, or behaviors, we will report this to the Suicide Prevention Team at Nationwide Children's Hospital. You will be notified if this occurs. If the Suicide Prevention Team believes other authorities need to be contacted, they will do so and will inform you of this as well.

The Protected Health Information collected or created under this research study will be used/disclosed as needed until the end of the study. The records of this study will be kept for an indefinite period of time.

You may decide not to authorize the use and disclosure of your PHI. However, if it is necessary for this study, you will not be able to be in this study. If you agree to be in this study and later decide to withdraw your participation, you may also withdraw your authorization to use your PHI. This request must be made in writing to the Principal Investigator. If you withdraw your authorization, no new PHI may be collected and the PHI already collected may not be used unless it has already been used or is needed to complete the study analysis and reports.

Dr. Brady Reynolds keeps a database of all subjects who participate in a research study. This database may be used to contact people about future studies. Only Dr. Reynolds and his staff have access to this database. The database will not be disclosed or sold to others outside Nationwide Children's Hospital.

Please initial:

____ I want to be contacted about future research studies.

____ I do not want to be contacted about future research studies.

11) WHOM SHOULD I CALL IF I HAVE QUESTIONS OR PROBLEMS?

If you have questions, concerns, or complaints about anything while on this study or you have been injured by the research, you have 24 hour access to talk to or leave a message for the Principal Investigator at 614-722-3549. Your call will be returned within 24 hours.

If you have questions, concerns, or complaints about the research, questions about your rights as a research volunteer, cannot reach the Principal Investigator, or want to call someone else, please call (614) 722-2708, Nationwide Children's Hospital Institutional Review Board, (IRB, the committee that reviews all research in humans at Nationwide Children's Hospital).

Subject's Name _____Date of Birth_____

SUBJECT or SUBJECT'S PARENT OR PERSON AUTHORIZED TO CONSENT ON BEHALF OF THE CHILD (SUBJECT TO THE SUBJECT'S GENERAL MEDICAL CARE)

I have read this consent form and have had a chance to ask questions about this research study. These questions have been answered to my satisfaction. If I have more questions about participation in this study or a research-related injury, I may contact the Principal Investigator. By signing this consent form, I certify that all health information I have given is true and correct to the best of my knowledge.

I agree to participate in this study, and I give permission for my child to participate in this study. I will be given a copy of this consent form with all the signatures for my own records.

CONSENT SIGNATURES

_____ _____

SUBJECT or SUBJECT'S LEGAL REPRESENTATIVE *DATE*

_____ _____

PERSON OBTAINING CONSENT **DATE**

I certify that I have explained the research, its purposes,
and the procedures to the subject or subject's legal representative before requesting their signature.

Appendix B

ID#_____

BIS-11-A

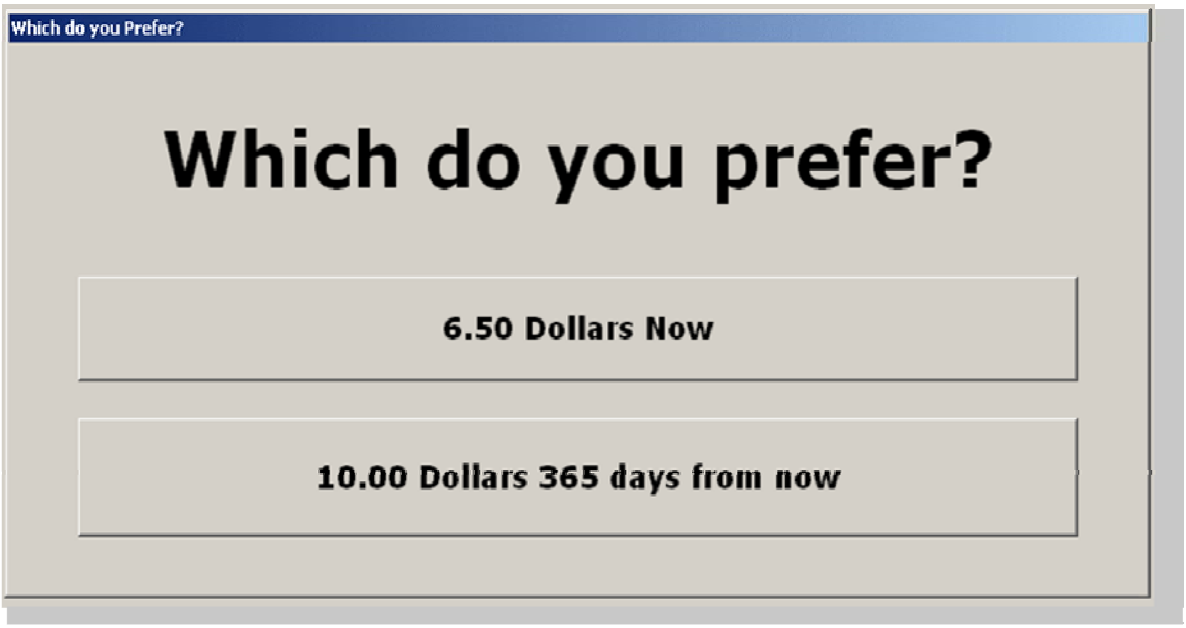
Directions:
People differ in the ways they act and think in different situations. This is a test to measure some of the ways in which you act and think. Read each statement carefully and **CIRCLE THE APPROPRIATE NUMBER** to the right of the statement. Answer quickly and honestly.

		Rarely/ Never	Occasionally	Often	Almost Always/Always
1.	**I plan what I have to do**.	1	2	3	4
2.	**I do things without thinking**.	1	2	3	4
3.	**I make up my mind quickly**.	1	2	3	4
4.	**I am happy-go-lucky**.	1	2	3	4
5.	**I do not "pay attention"**.	1	2	3	4
6.	**My thoughts are racing too fast**. .	1	2	3	4
7.	**I plan my spare time**.	1	2	3	4
8.	**I am self controlled**.	1	2	3	4
9.	**I concentrate easily**.	1	2	3	4
10.	**I am a "saver"**.	1	2	3	4
11.	**I cannot stand still at movies or school**.	1	2	3	4
12.	**I like to think carefully about things**.	1	2	3	4
13.	**I plan for my future**.	1	2	3	4
14.	**I say things without thinking**.	1	2	3	4
15.	**I like to think about complex problems**.	1	2	3	4
16.	**I change my mind about what I will do when I grow up**.	1	2	3	4
17.	**I act "on impulse"**.	1	2	3	4
18.	**I get easily bored when solving thought problems**.	1	2	3	4
19.	**I act on the spur of the moment**. . .	1	2	3	4
20.	**I am a great thinker**.	1	2	3	4

21.	**I change friends**.	1	2	3	4
22.	**I buy things on impulse**.	1	2	3	4
23.	**I can think about one problem at a time**.	1	2	3	4
24.	**I change hobbies and sports**.	1	2	3	4
25.	**I spend more than I should**.	1	2	3	4
26.	**When I think about something, other thoughts pop up in my mind**	1	2	3	4
27.	**I am more interested in the present than in the future**.	1	2	3	4
28.	**I am restless at the movies or lectures**.	1	2	3	4
29.	**I like to play chess or checkers**. . . .	1	2	3	4
30.	**I am future oriented**.	1	2	3	4

Appendix C

Delay Discounting



[Say]:
"You will be choosing between different amounts of money available after different delays ***OR*** *right now. There are no right or wrong answers to these questions… just pick what you prefer.* ***But****, the questions you answer are important because of your answers will be selected at random and you will get what you chose. If you chose delayed money, the money will be put in an envelope with your name and address on it, and it will be mailed to after the delay. For example if you chose $10 in 180 days from now, the $10 will be mailed to you in 180 days.*

In other words, you're choosing between two options that are presented on the screen. There's no right or wrong answer so pick what you prefer. At the end, one of the questions will be picked and you will get what you chose. So if you chose $10 in 2 days, that money will be mailed to you in 2 days. If you chose $3 now, that money will be added into your total earnings for today.

Any Questions?

"When you click on a choice, a box will pop up asking 'are you sure – yes or no'. If you're sure of your choice, click yes. If not, click no and it will bring you right back to the same question. Sometimes the 'yes' and 'no' boxes switch sides so be aware of that when clicking."

Appendix D

Weight-Related Eating Questionnaire (WREQ)

Directions: Please choose a response that best expresses how well each statement describes you. Please rate each question on how best it describes you.

Not at all=1; Slightly=2; More or Less=3; Pretty Well=4; Completely=5.

1. I purposefully hold back at meals in order not to gain weight.	**1 2 3 4 5**
2. I tend to eat more when I am anxious, worried, or tense.	**1 2 3 4 5**
3. I count calories as a conscious means of controlling my weight.	**1 2 3 4 5**
4. When I feel lonely I console myself by eating.	**1 2 3 4 5**
5. I tend to eat more food than usual when I have more available places that serve or sell food.	**1 2 3 4 5**
6. I tend to eat when I am disappointed or feel let down.	**1 2 3 4 5**
7. I often refuse foods or drinks offered because I am concerned about my weight.	**1 2 3 4 5**
8. If I see others eating, I have a strong desire to eat too.	**1 2 3 4 5**
9. Some foods taste so good I eat more even when I am no longer hungry.	**1 2 3 4 5**
10. When I have eaten too much during the day, I will often eat less than usual the following day.	**1 2 3 4 5**
11. I often eat so quickly I don't notice I'm full until I've eaten too much.	**1 2 3 4 5**
12. If I eat more than usual during a meal, I try to make up for it at another meal.	**1 2 3 4 5**
13. When I'm offered delicious food, it's hard to resist eating it even if I've just eaten.	**1 2 3 4 5**
14. I eat more when I'm having relationship problems.	**1 2 3 4 5**
15. When I'm under a lot of stress, I eat more than I usually do.	**1 2 3 4 5**
16. When I know I'll be eating a big meal during the day, I try to make up for it by eating less before or after that meal.	**1 2 3 4 5**